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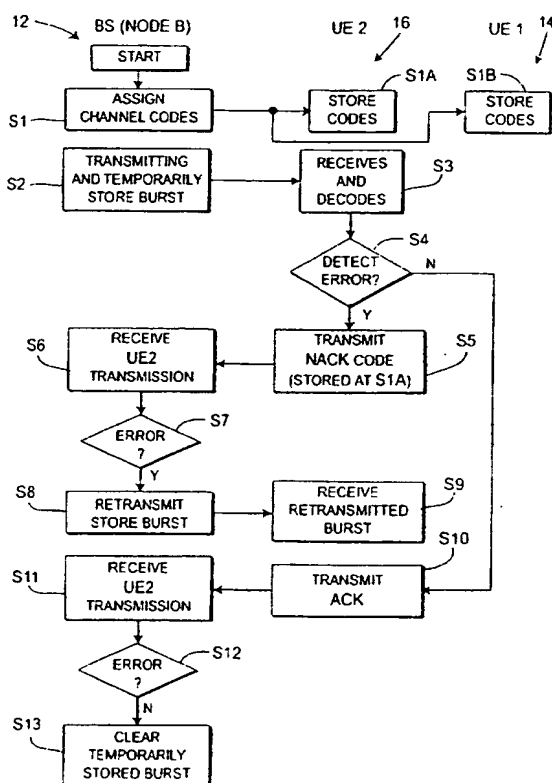
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[Continued on next page]

(54) Title: **METHOD AND APPARATUS FOR PROVIDING A HIGHLY RELIABLE ACK/NACK FOR TIME DIVISION DUPLEX (TDD) AND FREQUENCY DIVISION DUPLEX (FDD)**



(57) Abstract: An ACK/NACK method and system for use in time division duplex (TDD) and frequency division duplex (FDD) systems. In high speed downlink packet access (HSDPA), based on the assignment of timeslots for the high speed shared information channel (HS-SICH), each user equipment (UE) can be assigned two (2) different channelization codes. It is then possible to adopt the signaling convention that one code represents acknowledge error-free (Ack) and the other code shall represent acknowledge error condition (Nack). The Node B is able to distinguish the presence of the transmitted channelization code as opposed to the channelization code which is not transmitted. The probability of error, using this invention, is an order of a magnitude smaller than if the Ack/Nack were signaled using typical modulation techniques.

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ance Notes on Codes and Abbreviations" appearing at the begin-
ning of each regular issue of the PCT Gazette.*

[0001] **METHOD AND APPARATUS FOR PROVIDING A
HIGHLY RELIABLE ACK/NACK FOR TIME DIVISION DUPLEX
(TDD) AND FREQUENCY DIVISION DUPLEX (FDD)**

[0002] **FIELD OF INVENTION**

[0003] The present invention relates to the field of wireless communications. More specifically, the present invention relates to method and apparatus for providing a highly reliable Ack/Nack signal in the return channel, referred to as the high speed shared information channel (HS-SICH) in high-speed downlink packet access (HSDPA).

[0004] **BACKGROUND**

[0005] In HSDPA it is critical to have a highly reliable Ack/Nack signal in the return (uplink) channel, referred to as the High Speed Shared Information Channel HS-SICH. It is especially critical to recognize the Nack, because this is the message that indicates to the Network (the Node B) that it is required to retransmit data, which has failed to be correctly processed.

[0006] **SUMMARY OF THE INVENTION**

[0007] During a given time, up to eight (8) UEs are each assigned two (2) unique channelization codes, respectively representing ACK and NACK signals, which are easily distinguished from one another by the network (Node B).

[0008] **BRIEF DESCRIPTION OF THE DRAWING(S)**

[0009] The sole figure is a simplified system diagram useful in explaining the technique and apparatus of the present invention

[0010] **DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT(S)**

[0011] Within a time division duplex (TDD) cell, for any given slot, there are 16 channelization codes available, both for uplink and downlink. In the HSDPA application, a given timeslot will be assigned for the HS-SICH. Without introducing a serious operational limitation, it can be assumed that no more than eight user equipments (8 UEs) will be receiving highspeed data at a given time.

Therefore, no more than eight (8) UEs will be transmitting uplink in the assigned HS-SICH timeslot.

[0012] Therefore, each UE can be assigned two (2) channelization codes. It is then possible to adopt the signaling convention that one code represents ACK (previous downlink data burst was successful) and the other code shall represent Nack (previous downlink data burst was unsuccessful). Furthermore, the well documented set of additional uplink control information, e.g. Channel Quality Indicator (CQI), and Transmit Power Control (TPC) can be modulated onto the selected channelization code.

[0013] The Node B is easily and readily able to distinguish the presence of the transmitted channelization code as opposed to the other channelization code, which is not transmitted. The probability of error, employing the technique of the present invention, will be an order of magnitude smaller than if the Ack/Nack were signaled using typical modulation techniques.

[0014] This invention is particularly well suited to TDD, because there is no additional cost associated with the allocation of all sixteen (16) codes in the slot. It is also noted that, even though sixteen (16) codes are allocated, with eight (8) UEs transmitting in the slot, only eight (8) codes will be used at any one time. This invention may also be used in frequency division duplex (FDD) transmissions for signaling Ack/Nack for HSDPA.

[0015] The sole figure of the application shows a system 10 comprised of a base station (Node B) 12 and a plurality of user equipments (UEs). In the example given, only two (2) user equipments (UEs) are shown for purposes of simplicity, it being understood that the number serviced by the BS 12 may be quite substantial. In the example, the first and second UEs 14 and 16 are serviced by the BS which can serve one or multiple cells.

[0016] BS 12, at step S1, assigns each UE a pair of channelization codes wherein each of the pair of channelization codes assigned to each UE 14 and 16 differ from one another. Each code of the channelization code pairs are respectively designated for use to represent an ACK and a NACK condition. UE2-16 and UE1-14 store their assigned code pairs, at S1A and S1B.

[0017] BS 12, at step S2 transmits a burst such as burst type 1 to a number of UEs. In the example given, BS 12, at step S2, transmits to UE2-16. UE2-16, at step S3 receives and decodes the burst. At step S4 UE2-16 determines if there is an error present in the reception. If an error is detected, the routine branches to step S5 causing the channelization code assigned as a Nack code to be transmitted to the BS12. BS12, at step S6, receives the code and, if an error channelization code (Nack) is detected, at step S7, the routine branches to step S8 to retransmit the temporarily stored burst to UE2-16 which receives the retransmitted burst at step S9.

[0018] Assuming the burst received by UE2-16 at step S3 is error free, UE2-16, at step S4 branches to step S10 to transmit the channelization code assigned to UE2-16 to designate an ACK condition. BS12, at step S11, receives this channelization code representing an ACK signal and, at step S12, detecting that there is no error, branches to step S13 to clear the burst which was temporarily stored.

[0019] Although not shown for purposes of simplicity, it should be understood that up to six (6) additional UEs beyond UE1-14 and UE2-16, may be communicating with BS12 at the same time.

[0020] As was described hereinabove, the maximum number of UEs will be transmitting only one code (either an Ack or an Nack code) at one time, thus limiting the total number of channelization codes transmitted at one time to eight (8). The technique described herein above is well suited to both TTD and FDD.

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CLAIMS

What is claimed is:

1. A method for providing a highly reliable acknowledge - correct/acknowledge - error (ACK/NACK) capability for use by user equipments (UEs) in a wireless network, comprising:

a base station (BS) providing a plurality of channelization codes for use in a time slot, each of said channelization codes being different from one another;

said BS assigning two (2) of said channelization codes to at least one UE;

and

said BS designating one (1) of the two (2) channelization codes as an ACK signal and the other one of the pair of channelization codes as a NACK signal.

2. The method of claim 1 wherein the step of providing includes providing twice as many channelization codes as are needed, based on demand; e.g. sixteen (16) different channelization codes, where only 8 are actually needed to satisfy the required demand.

3. The method of claim 2 wherein the step of assigning further includes:

assigning seven (7) different pairs of the remaining channelization codes to up to seven (7) more UEs in addition to said at least one UE; and

said BS, for each of the seven (7) different pairs, designating one (1) of the two (2) channelization codes in each pair as an ACK signal and the other one of the pair of channelization codes in each pair as a NACK signal. This also applies if each UE is assigned N channelization codes for Ack and another N channelization codes for Nack. Then the method of claim 2 wherein the step of assigning further includes:

assigning N-1 different pairs of the remaining channelization codes to up to N-1 more UEs in addition to said at least one UE; and

said BS, for each of the N-1 different pairs, designating one (1) of the two (2) channelization codes in each pair as an ACK signal and the other one of the pair of channelization codes in each pair as a NACK signal.

4. The method of claim 1 further comprising:

said base station transmitting a burst to said at least one UE;

said at least one said UE determining whether the transmitted burst contains an error; and

said at least one UE transmitting the channelization code assigned to the UE to identify a burst having an error to the BS by, transmitting the channelization code representing a NACK condition.

5. The method of claim 1 further comprising:

said base station transmitting a burst to said at least one UE;

said at least one UE determining whether the transmitted burst contains an error;

said at least one UE transmitting the channelization code assigned to said at least one UE to identify an error-free burst to the BS by, transmitting the channelization code representing a ACK condition.

6. Apparatus for providing a highly reliable acknowledge - correct/acknowledge - error (ACK/NACK) capability for use by user equipments (UEs) in a wireless network, comprising:

a base station (BS) having means for providing a plurality of channelization codes for use in a time slot, each of said channelization codes being different from one another;

said BS having means for assigning two (2) of said channelization codes to at least one UE; and

said BS having means for designating one (1) of the two (2) channelization codes as an ACK signal and the other one of the pair of channelization codes as a NACK signal.

7. The apparatus of claim 6 wherein said providing means includes means to provide sixteen (16) different channelization codes.

8. The apparatus of claim 1 wherein the means for assigning further includes means for assigning seven (7) different pairs of the remaining channelization codes to up to seven (7) more UEs in addition to said at least one UE; and

said BS designating means designating for each of the remaining UEs, one (1) of the two (2) channelization codes as an ACK signal and the other one of the pair of channelization codes as a NACK signal.

9. The apparatus of claim 6 further comprising:

said base station including means for transmitting a burst to said at least one UE;

said at least one said UE having means for determining whether the transmitted burst contains an error; and

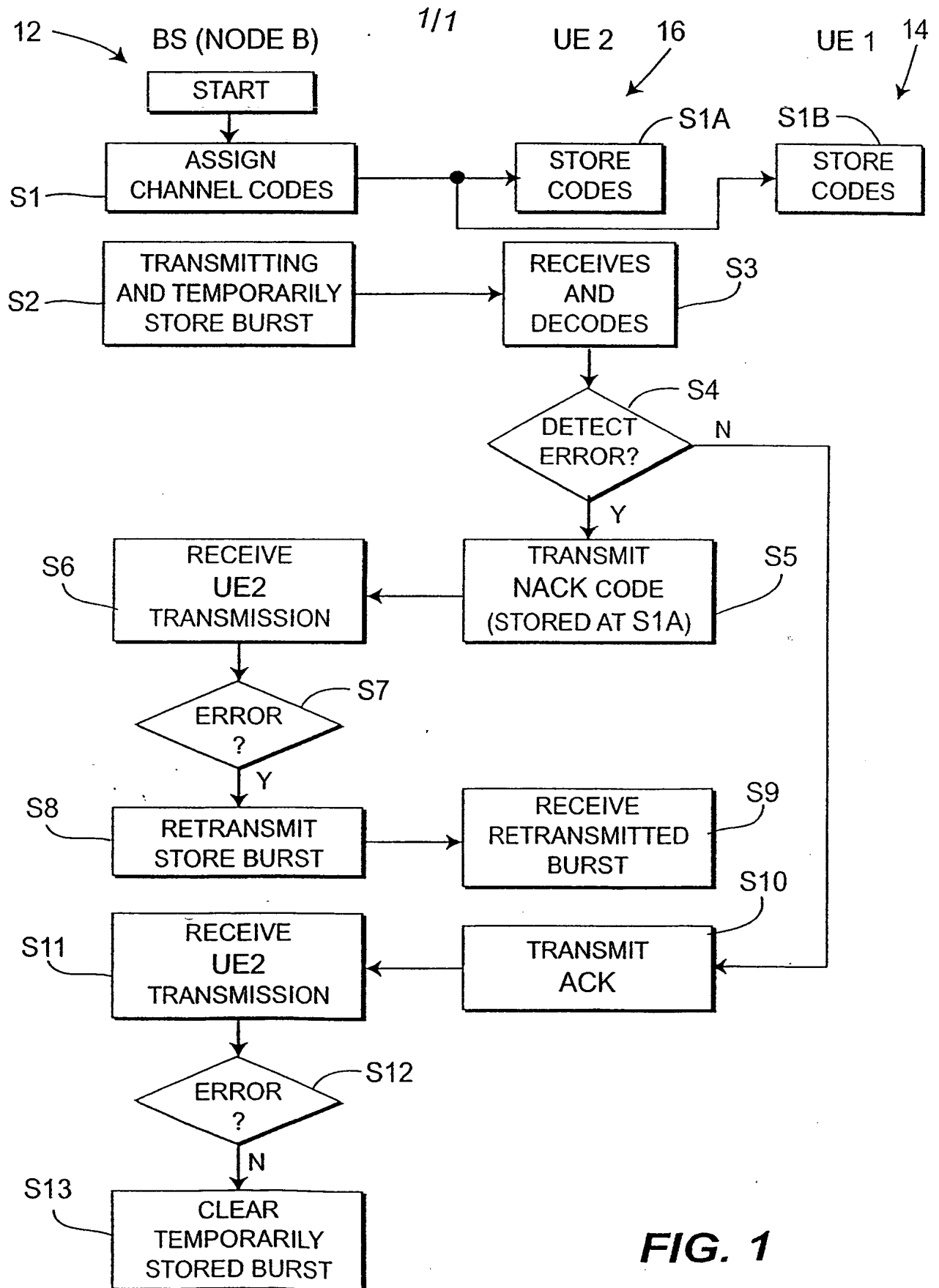
said at least one UE having means for transmitting the channelization code assigned to the UE to identify a burst having an error to the BS by, transmitting the channelization code representing a NACK condition.

10. The apparatus of claim 6 further comprising:

said base station including means for transmitting a burst to said at least one UE;

said at least one said UE determining whether the transmitted burst contains an error; and

said at least one UE having means for transmitting the channelization code assigned to the UE to identify an error-free burst to the BS by, transmitting the channelization code representing a ACK condition.

**FIG. 1**

INTERNATIONAL SEARCH REPORT

International application No.

PCT/US03/04824

A. CLASSIFICATION OF SUBJECT MATTER

IPC(7) : H04J 3/24

US CL : 370/277, 278, 282, 294; 709/232; 714/748, 749

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

U.S. : 370/277, 278, 282, 294; 709/232; 714/748, 749

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
EAST**C. DOCUMENTS CONSIDERED TO BE RELEVANT**

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 5,377,192 A (GOODINGS et al) 27 December 1994, column 16, lines 43-68, column 17, lines 1-65.	1, 4, 5, 6, 8, 9, 10
A	US 5,537,414 A (TAKIYASU et al) 16 July 1996 Fig. 18 and 19	1, 6
A	US 4,905,234 A (CHILDRRESS et al) 27 February 1990, column 15 lines 35-68, column 16, lines 1-59.	1, 6

☐ Further documents are listed in the continuation of Box C.
 ☐ See patent family annex.

* Special categories of cited documents:	
"A" document defining the general state of the art which is not considered to be of particular relevance	"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"E" earlier application or patent published on or after the international filing date	"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)	"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"O" document referring to an oral disclosure, use, exhibition or other means	"&" document member of the same patent family
"P" document published prior to the international filing date but later than the priority date claimed	

Date of the actual completion of the international search 06 June 2003 (06.06.2003)	Date of mailing of the international search report 11 JUL 2003
Name and mailing address of the ISA/US Mail Stop PCT, Attn: ISA/US Commissioner for Patents P.O. Box 1450 Alexandria, Virginia 22313-1450 Facsimile No. (703)305-3230	Authorized officer Hassan Kizou Telephone No. 703-305-4750

INTERNATIONAL SEARCH REPORT

International application No.

PCT/US03/04824

Box I Observations where certain claims were found unsearchable (Continuation of Item 1 of first sheet)

This international report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☒ Claim Nos.: 3
because they relate to subject matter not required to be searched by this Authority, namely:
claim 3 seems to contain limitations of two claims. Claim 3 as written is not understandable.
2. ☐ Claim Nos.:
because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:
3. ☐ Claim Nos.:
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

Box II Observations where unity of invention is lacking (Continuation of Item 2 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

1. ☐ As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims.
2. ☐ As all searchable claims could be searched without effort justifying an additional fee, this Authority did not invite payment of any additional fee.
3. ☐ As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos.:
4. ☐ No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

Remark on Protest

☐
☐

- The additional search fees were accompanied by the applicant's protest.
No protest accompanied the payment of additional search fees.

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